4. Maintain these conditions until the catalyst support frame is uniformly heated.
5. Increase the turbine power slowly, keeping the catalyst support frame uniformly heated with no hot spots, through the time when maximum output is achieved.

The EmeraChem catalyst system is designed to operate, to the largest degree possible, in the same thermal environment as the duct and HRSG; however, during initial exhaust gas release to the catalyst system, extra precaution should be taken to reduce thermal shock and possible distortion. A gradual temperature increase is optimal. As with all equipment exposed to the extreme temperatures of gas turbine exhaust, it is desirable to minimize thermal shock, temperature spikes, excursions and unnecessary thermal cycling.

After initial start-up, check the following items:

1. Check the duct liner for buckled or loose plates.
1. Check the frame for cracks or broken parts.
2. Check the expansion seals for buckled or binding components.
3. Check that the bent seal plates are intact.
4. Check the frame integrity; look for bent/buckled items, frame position within the HRSG, etc.

9.2 Catalyst Installation

Typically catalyst modules are installed after commissioning, inspection, and the initial turbine firing. The frame temperature should be less than 110 ° F prior to catalyst installation. An EmeraChem field representative should observe and inspect the initial installation of catalyst modules and test coupons.

The first step is to install access equipment (platforms, scaffolding, or other equipment) that allows the installation crew safe access to the front face of the frame. All applicable local and national safety procedures must be adhered to, with workers using safety harnesses and safety lines.

The components needed for the catalyst installation are as follows:

1. Catalyst modules
2. Fiberglass gasket
3. Catalyst hold down plates
4. Nuts (2 per stud)

The catalyst hold down plates are shown in Figure 3 below. Additionally, these components are shown in the drawing details in Appendix E.

Once the access equipment is installed and ready to use, begin the catalyst installation at the top of the catalyst support frame. Installing the catalyst from top to bottom will help to prevent damage to the catalyst substrate during assembly.

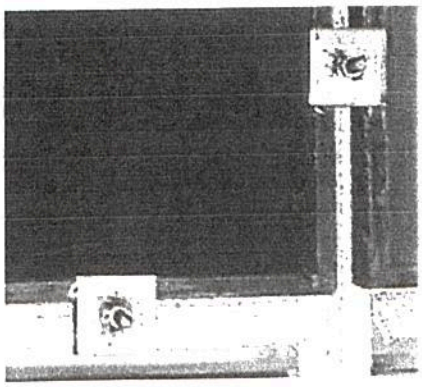
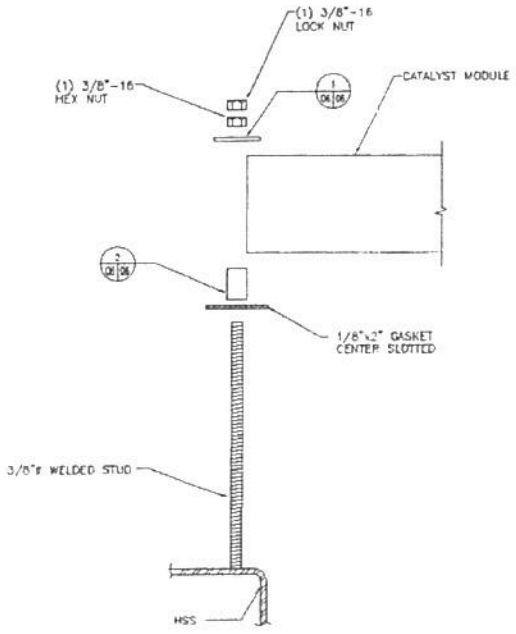


Figure 4: Catalyst Hold Down Plates

First, place the gasket along all members of the catalyst frame. The gasket is slotted and will slide over the studs provided for securing the catalyst modules. Beginning at the top of the unit, apply gasket material to all vertical members. Then, apply gasket to all horizontal members, cutting the horizontal gasket material at the intersections with the vertical gasket material

to provide a snug fit without gaps. Do not overlap gasket. Gaps and overlaps in gasket will cause bypass leakage and degrade performance. Place spacers over each of the studs. Next, place the catalyst module between the spacers on the frame (on top of the gasket).



CATALYST HOLD DOWN SECTION

If the gasket appears out of position, use a long, thin tool (i.e. screwdriver) to move it into position, making sure not to tear the gasket. Visually inspect the seal with a flashlight. If the gasket is not seated properly, gas will bypass the catalyst.

If viewed from the downstream side of the frame, the edge of the gasket should just be visible, roughly parallel with the edge of the frame. This indicates the gasket is properly placed.

After the module is seated in the frame, secure the module by installing a catalyst hold down plate and securing it with one nut. Some catalyst hold

down plates serve to secure two modules, so those plates should only be added after the adjacent module is installed. Once the hold down plates are secured with one nut, a second nut, acting as a jamb nut, is tightened against the first. Prevent the first nut from turning and thus changing the torque while the second nut is tightened.

Follow this sequence working across the frame, progressing from the top to the bottom.

Once the catalyst modules have been completely installed and prior to re-starting the system, the following should be checked:

1. Check for proper seal installation from the downstream side of the frame, looking for even placement of the gasket between the modules and frame.
2. Any gaps (corner, sides) should be eliminated to prevent bypass.
3. Inspect the bent seal plates that seal the frame against the HRSG. Examine for bypass.
4. Ensure all catalyst hold down washers are secured by two nuts and are tight.

Smaller test catalyst modules have been provided (four modules per location) as shown in Appendix E and in the System Specifications (page vii). Installation and removal of test catalyst modules shall be completed as detailed above.

UNDER NO CIRCUMSTANCE SHOULD THE CO CATALYST BE EXPOSED TO DIRECT FLAME.

9.3 Final Inspection

Once the catalyst has been installed, the turbine will likely be started and operated at normal operating temperature for testing and data gathering. It is important, if the opportunity arises, to inspect the ADCAT™ CO Catalyst

system again after this period of operation. The following items should be checked:

1. Examine the gaskets on the frame for gaps/potential bypass.
2. Check the frame for cracks, broken welds, and disfigured components.
3. Check that the frame has not shifted during operation.
4. Examine the catalyst to ensure that debris has not blocked off the catalyst surface.
5. Check seal plates where the frame and duct liner meet to ensure they are tight against the frame with no room for bypass.

10.0 SAFETY CONSIDERATIONS

The ADCAT™ CO Catalyst system is designed to oxidize carbon monoxide as the gas turbine exhaust passes over the precious metal-coated catalyst at elevated temperatures. These high temperatures make it mandatory that personnel be protected against injury. Do not attempt to work around the ADCAT™ CO Catalyst system if temperatures exceed 110° F.

Always use caution when working around the ADCAT™ CO Catalyst system during a shutdown period. If the system shuts down because of a high temperature or any other reason, pay particular attention to hot surfaces and make sure there is adequate area ventilation. This is especially important when inspecting, removing, or installing the ADCAT™ CO Catalyst system.

If necessary, use a ventilation fan to keep fresh air flowing through the system during inspection, removal, or installation. All appropriate OSHA confined space safety procedures, as well as all local and company procedures should be followed at all times.

Any time the ADCAT™ CO Catalyst system is not in operation because of the need to perform maintenance work, use the appropriate equipment lockout measures.

Use proper personnel protection at all times when installing or removing catalyst modules. Read the recommendations below before starting any procedures:

1. Follow all appropriate OSHA and plant safety procedures at all times, including equipment lockout / tag out and confined space entry procedures.
2. Provide adequate ventilation.
3. Wear leather gloves when handling catalyst modules. Metal edges of the modules are sharp and can cut and bruise.
4. Wear safety glasses with side shields or goggles when installing or removing modules from the frame. Protruding threading studs on the frames may often be at eye level.
5. Wear safety shoes and a hard hat.
6. Wear appropriate fall protection equipment as required during module loading.
7. Modules should be lifted within a lifting fixture during loading.
8. Precautions should be taken to prevent injury from falling objects while loading modules (nuts, hold down plates, modules, tools).
9. Review the operation of the ADCAT™ CO Catalyst system with the plant safety officer before starting the unit. Any suggestions and additions should be added to those instructions.

All those involved in the operation of the ADCAT™ CO Catalyst system should read and understand the complete operating instructions before starting the system. Safety meetings of all those involved with the ADCAT™ CO Catalyst system should be held periodically in conjunction with housekeeping reviews.

11.0 11.0 OPERATION LOG

To maintain compliance with warranty provisions, process operating logs must be maintained. These operating logs are to contain record of the operating conditions of the system. The conditions are to be recorded on a regular basis, not less than every 24 hours. These process operating logs shall be available to EmeraChem at all times during the warranty period. (Refer to appendix F – Warranty for further information.)

12.0 REVISIONS AND CHANGES

EmeraChem reserves the right to amend the Operation and Maintenance Manual as necessary. Such amendments to the Operation and Maintenance Manual shall not be applied retroactively in determining the customer's warranty compliance. (Refer to appendix F – Warranty for further information.)

Scope

This operating manual covers the basic procedures for the Cormetech customer for safety, handling, and operation of Cormetech® SCR Catalysts.

For further clarification, please direct inquiries to CORMETECH. Extensive contact information is contained Appendix 5.

SCR Overview

SCR System General Description

The process of selective catalytic reduction (SCR) of combustion flue gases reduces nitrogen oxides (NOx) into molecular nitrogen (N_2) and water (H_2O). NOx breaks down when it reacts with a reducing agent, usually ammonia (NH_3), in the presence of a catalyst. The NH_3 is mixed thoroughly with the flue gas prior to the catalyst. The mixing assures even distribution of the temperature and reaction components. The catalyst, by providing active reaction sites, allows the reaction to occur at temperatures between 300° - 1,050°F. The NH_3 diffuses into the catalyst pore structure and is adsorbed onto an active catalyst site. The NOx then reacts with the adsorbed NH_3, completing the reaction. The reaction depends primarily on available active sites (a function of geometric surface area, pore volume, and concentration of active catalyst component), flue gas temperature, and reagent concentration. A well-balanced process will maintain appropriate output levels of residual NOx and NH_3.

Cormetech® catalysts are extruded ceramic structures composed of inorganic oxides. These extruded catalysts are homogeneous, in that, the entire element is composed of a uniform distribution of catalytic material. Usually, the catalysts are assembled into steel modules that are arranged in the SCR reactor to efficiently contact the flue gases during system operation.

SCR Chemistry

The most significant reactions that reduce NO and NO_2 with NH_3 are the following:

1) $4NO + O_2 + 4NH_3 \rightarrow 4N_2 + 6H_2O$

2) $NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$

3) $6NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O$

The first reaction is the predominant reaction. It shows that one mole of ammonia is consumed for each mole of NO removed. However, in an actual system, slightly more ammonia is injected than necessary for the desired NO removal, to account for imperfect mixing. The excess ammonia which passes through the catalyst bed non-reacted is called ammonia slip.

Some consequential reactions may also take place under certain operating conditions. Specifically:

4) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

5) $2SO_2 + O_2 \rightarrow 2SO_3$

6) $2NH_3 + SO_3 + H_2O \rightarrow (NH_4)_2SO_4$

7) $NH_3 + SO_3 + H_2O \rightarrow (NH_4)HSO_4$

Reaction number (4), ammonia oxidation, is not significant at normal operating temperatures below 800°F. As the flue gas temperature increases, the NH_3 oxidizes more readily, increasing the concentration of NO and decreasing the available NH_3 for the SCR process.

Reaction number (5) is not important with low sulfur fuels or natural gas, but if CO oxidation catalysts are in the flow stream, the SO_2 concentration may increase anyway. The sulfur in the fuel generates SO_2 and SO_3 (SO_x) during combustion. The presence of SO_3 in the flue gas can lead to the formation of ammonium sulfate and ammonium bisulfate as shown in reaction equations (6) and (7) respectively. Once formed, these substances may deposit on the catalyst and other system equipment, reducing the system performance. If minor deposition occurs, this reaction may be reversible and system performance subsequently recovered by operating the system at elevated temperatures. In the event of the occurrence of sulfate deposits, immediately contact CORMETECH for proper operating guidelines and corrective action. See Appendix 5 for detailed contact information.

When operated as designed, the SCR process has limited impact on the boiler or process operations. The process is capable of reducing NOx without creating additional pollutants. It performs reliably and achieves high NOx reduction under varying loads. Furthermore, a well operating SCR system has very limited impact on operation of downstream equipment.

SCR Catalyst

SCR performance is dependent on the catalyst properties. Cormetech® catalyst is a titanium-tungsten based material that is highly reactive to NOx. Cormetech® catalyst is an extruded ceramic honeycomb structure with high geometric surface area per unit volume. The high void fraction will minimize pressure losses. The Cormetech® catalyst formulation is tailored for use in each specific SCR system application. Cormetech® catalyst is also selective by reducing NOx, while restricting the oxidation of NH_3 to NO or SO_2 to SO_3. It is tolerant of flue gas contaminants, including ash particles.

Catalyst Degradation Mechanisms

Cormetech® catalyst is designed to resist degradation. However, over time the catalyst performance potential may decline, because of a reduction in available active sites, or a masking of the pores which prevents access to the active sites.
The following table shows some of the mechanisms which reduce performance potential.

THERMAL		
Degradation Source	*Mechanism*	*Measurement Methods*
High Temperature (onset temperature depends on specific catalyst formulation)	Reduce available catalytic surface area.	Nitrogen BET Surface Area, XRD, XRF, Mercury Porosimetry

LIQUID CONTACT		
Degradation Source	*Mechanism*	*Measurement Methods*
Water, Liquid Ammonia, Cleaning Solution	Liquids act as carriers of poisons that may decrease catalytic performance. Rapid heat-up of liquids may cause cracks and reduce physical integrity. Resilient sealing materials break down and may dislodge over time, allowing flue gas bypass in a catalyst module encasement.	Chemical analysis, physical inspection and physical property measurements

POISONS		
Degradation Source	*Mechanism*	*Measurement Methods*
Fine Particulate	Plug pores and prevent diffusion/reaction.	SEM/EDS of surface
Alkaline Metals	Ion exchange with active sites. Common: Sodium, Potassium Other: Cesium, Lithium, Rubidium	ICP, ICPMS, XRF, XPS, SEM/EDS
Alkaline Earth Metals	Plug pores and prevent diffusion/reaction, typically in the form of sulfates, phosphates or arsenates. Common: Calcium, Magnesium Other: Barium, Strontium, Beryllium	ICP, ICPMS, XRF, XPS, SEM/EDS
Ammonia-Sulfur Compounds	Plug pores and prevent diffusion/reaction.	Ion Chromatography, XRF, XPS,SEM/EDS
Halogens	At high levels, react with and volatilize active metal sites of catalyst.	Ion Chromatography, ICP, ICPMS, XRF, XPS, SEM/EDS
Silicon Compounds	Form siliceous compounds on surface that mask active sites and/or plug pores. Common: Siloxanes	ICP, ICPMS, XRF, XPS, SEM/EDS
Noble Metals	Promote oxidation of ammonia to NOx. Common: Platinum Other: Palladium, Rhodium	ICP, ICPMS, XRF, XPS, SEM/EDS
Other Elements	Cover active sites, deposit on or near catalyst surface, or promote oxidation (ammonia to NOx or SO_2 to SO_3). Common: Arsenic, Phosphorus Other: Antimony, Chrome, Copper, Iron, Lead, Nickel, Tin, Vanadium, Zinc	ICP, ICPMS, XRF, XPS, SEM/EDS

For any contaminant elements not listed, please contact Cormetech at sales@cormetech.com or (919) 620-3000. Surface/bulk/other methods may be utilized, combined or replaced, as appropriate, for suitability.

ICP = Inductively Coupled Plasma

ICPMS = Inductively Coupled Plasma Mass Spectroscopy

XRD, XRF, XPS = X-Ray Diffraction, X-Ray Fluorescence & X-Ray Photoelectron Spectroscopy

SEM/EDS = Scanning Electron Microscopy/Energy Dispersive Spectroscopy

1. MSDS C-405 - SCR Systems NOx Catalyst

Material Safety Data Sheet

Material Name: SCR Systems NOx Catalyst

ID: C-405

* * * Section 1 - Chemical Product and Company Identification * * *

Manufacturer Information

Cormetech, Inc.
5000 International Drive
Durham, NC 277712

Phone: (919) 620-3023

Emergency # 24 Hr CHEMTREC U.S. (800) 424-9300
24 Hr CHEMTREC International (703) 527-3887

* * * Section 2 - Hazards Identification * * *

Emergency Overview

Product is a yellowish green to gray solid. This product may be irritating to the eyes, respiratory system and skin. At very high exposure levels the dusts from this product may cause damage to the lungs. Components may cause allergic skin sensitization reaction.

Hazard Statements

Dust or powder may be irritating to the eyes, skin, respiratory system and gastrointestinal tract.

Potential Health Effects: Eyes

Dust or powder may irritate eye tissue. Rubbing may cause abrasion of cornea.

Potential Health Effects: Skin

Dust or powder may irritate the skin. Mechanical rubbing may increase skin irritation. A component in this product may cause allergic skin reactions.

Potential Health Effects: Ingestion

May cause temporary irritation of the throat, stomach, and gastrointestinal tract. Acute ingestion may be harmful.

Potential Health Effects: Inhalation

Dusts from this product may cause irritation of the nose, throat, and respiratory tract. When inhaled in very large amounts, damage to the lung can occur.

HMIS Ratings: Health: 1 Fire: 1 Physical Hazard: 0 Pers. Prot.: Safety glasses, gloves
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
66402-68-4	Ceramic materials and wares, chemicals	100
1314-35-8	Tungsten oxide (**See NOTE Below)	<24
1314-62-1	Vanadium Pentoxide (**See NOTE Below)	<5

Component Related Regulatory Information

This product may be regulated, have exposure limits or other information identified as the following: Nuisance particulates, Tungsten, insoluble compounds.

Component Information/Information on Non-Hazardous Components

This product is a ceramic solid material created by combining various raw materials (e.g. oxides, etc.), heating these components together and cooling to a solid having its own unique properties.

Processing of this article may produce dusts or fumes which are considered hazardous under U.S. 29 CFR 1910.1200 (Hazard Communication) and the Canadian Controlled Product Regulations.

**NOTE: This is not a separate component. It is included in the Ceramic Materials and Wares component. This product was tested for orthorhombic Vanadium Pentoxide and none was detected above the detection limit of 0.2 to 0.5%. The actual likelihood of any orthorhombic form of Vanadium Pentoxide being present in the fired product is negligible.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact, immediately flush eyes with large amounts of water, continuing to flush for 15 minutes. Get medical attention if irritation persists.

Material Safety Data Sheet

CORMETECH
ID: C-405

Material Name: SCR Systems NOx Catalyst

First Aid: Skin
Immediately flush exposed area with large amounts of water while removing contaminated clothing. Get medical attention if irritation persists. Launder contaminated clothing before reuse.

First Aid: Ingestion
Do not induce vomiting. Seek medical attention if material is ingested.

First Aid: Inhalation
If inhaled, remove person to fresh air. If symptoms develop or persist, get medical attention.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards
See Section 9 for Flammability Properties.
Material is not a fire hazard. Material may give off metallic oxides if exposed to high temperatures.

Hazardous Combustion Products
Metallic oxides may be given off at high temperatures.

Extinguishing Media
Use methods for the surrounding fire.

Fire Fighting Equipment/Instructions
Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Fire fighters should avoid inhaling any combustion products.

NFPA Ratings: Health: 1 Fire: 1 Reactivity: 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

* * * Section 6 - Accidental Release Measures * * *

Containment Procedures
Avoid creating dusts. Eliminate sources of ignition.

Clean Up Procedures
Wear appropriate protective equipment and clothing during clean-up. Collect spill using a vacuum cleaner with a HEPA filter. Place in a closed container.

Evacuation Procedures
None necessary.

Special Procedures
Clean up and dispose of waste in accordance with all Federal, State and local regulations.

* * * Section 7 - Handling and Storage * * *

Handling Procedures
Avoid generation of airborne dusts. Do not inhale dusts. Do not allow material to come into contact with eyes or skin.

Storage Procedures
Store in a cool, dry area.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Exposure Guidelines

A: General Product Information
The OSHA (Vacated) air contaminants exposure limits (PELs) are those provided in the 1989 update to 29 CFR 1910.1000. These limits were vacated by OSHA and may not be enforceable.

Material Safety Data Sheet

ID: C-405

Material Name: SCR Systems NOx Catalyst

B: Component Exposure Limits

Ceramic materials and wares, chemicals (66402-68-4)

ACGIH:	10 mg/m3 TWA (inhalable particles, recommended); 3 mg/m3 TWA (respirable particles, recommended) (related to Particulates (insoluble or poorly soluble) not otherwise specified (PNOS))
OSHA (Final):	15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction) (related to Particulates not otherwise regulated)
OSHA (Vacated):	15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction) (related to Particulates not otherwise regulated)
Alberta:	10 mg/m3 TWA (total particulate); 3 mg/m3 TWA (respirable particulate) (related to Particulates not otherwise regulated)
British Columbia:	10 mg/m3 TWA (inhalable); 3 mg/m3 TWA (respirable) (related to Particles (insoluble or poorly soluble) not otherwise specified)
Manitoba:	10 mg/m3 TWA (total dust containing no asbestos and <1% free silica) (related to Nuisance particulates)
New Brunswick:	10 mg/m3 TWA (particulate matter containing no asbestos and < 1% crystalline silica, inhalable fraction); 3 mg/m3 TWA (particulate matter containing no asbestos and < 1% crystalline silica, respirable fraction) (related to Particulates not otherwise classified (PNOC))
NW Territories:	5 mg/m3 TWA (respirable mass); 10 mg/m3 TWA (total mass) (related to Nuisance particulate)
Nova Scotia:	10 mg/m3 TWA (inhalable particulate, recommended); 3 mg/m3 TWA (respirable particulate, recommended) (related to Particulates (insoluble or poorly soluble) not otherwise specified (PNOS))
Nunavut:	5 mg/m3 TWA (respirable mass); 10 mg/m3 TWA (total mass) (related to Nuisance particulate)
Ontario:	10 mg/m3 TWAEV (inhalable); 3 mg/m3 TWAEV (respirable) (related to Particulates (insoluble or poorly soluble) Not Otherwise Classified (PNOC))
Quebec:	10 mg/m3 TWAEV (total dust, containing no asbestos and less than 1% crystalline silica) (related to Particulates not otherwise classified (PNOC))
Saskatchewan:	10 mg/m3 TWA; 3 mg/m3 TWA (respirable size) (related to Particulates, n.o.c.) 20 mg/m3 STEL; 6 mg/m3 STEL (respirable size) (related to Particulates, n.o.c.)

Material Safety Data Sheet

ID: C-405

Material Name: SCR Systems NOx Catalyst

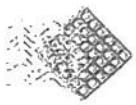
Tungsten oxide (1314-35-8)

ACGIH:	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
OSHA (Vacated):	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
NIOSH:	5 mg/m3 TWA (as W) (related to Tungsten (insoluble compounds))
	10 mg/m3 STEL (as W) (related to Tungsten (insoluble compounds))
Alberta:	5 mg/m3 TWA (as W) (related to Tungsten insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten insoluble compounds)
British Columbia:	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
Manitoba:	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
New Brunswick:	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
NW Territories:	5 mg/m3 TWA (as W) (related to Tungsten insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten insoluble compounds)
Nova Scotia:	5 mg/m3 TWA (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten, insoluble compounds)
Nunavut:	5 mg/m3 TWA (as W) (related to Tungsten insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten insoluble compounds)
Ontario:	5 mg/m3 TWAEV (as W) (related to Tungsten, water-insoluble compounds)
	10 mg/m3 STEV (as W) (related to Tungsten, water-insoluble compounds)
Quebec:	5 mg/m3 TWAEV (as W) (related to Tungsten, insoluble compounds)
	10 mg/m3 STEV (as W) (related to Tungsten, insoluble compounds)
Saskatchewan:	5 mg/m3 TWA (as W) (related to Tungsten insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten insoluble compounds)
Yukon:	5 mg/m3 TWA (as W) (related to Tungsten insoluble compounds)
	10 mg/m3 STEL (as W) (related to Tungsten insoluble compounds)

Vanadium Pentoxide (1314-62-1)

ACGIH:	0.05 mg/m3 TWA (dust or fume, respirable fraction)
OSHA (Vacated):	0.05 mg/m3 TWA (respirable dust, as V2O5); 0.05 mg/m3 TWA (fume, as V2O5)
NIOSH:	0.05 mg/m3 Ceiling (15 min, dust and fume, as V, except Vanadium metal and Vanadium carbide (see Ferrovanadium dust))
Alberta:	0.05 mg/m3 TWA (respirable fume or particulate, as V2O5)
British Columbia:	IARC Category 2B - Possible Human Carcinogen
	0.2 mg/m3 TWA (total dust, as V2O5)
	0.05 mg/m3 Ceiling (respirable dust and fume, as V2O5)
Manitoba:	0.05 mg/m3 TWA (as V2O5, respirable dust and fume)
New Brunswick:	0.05 mg/m3 TWA (respirable dust or fume, as V2O5)
NW Territories:	0.5 mg/m3 TWA (dust, as V)
	1.5 mg/m3 STEL (dust, as V)
	0.05 mg/m3 Ceiling (fume, as V)
Nova Scotia:	0.05 mg/m3 TWA (dust or fume, respirable fraction, as V2O5)
Nunavut:	0.5 mg/m3 TWA (dust, as V)
	1.5 mg/m3 STEL (dust, as V)
	0.05 mg/m3 Ceiling (fume, as V)
Ontario:	0.05 mg/m3 TWAEV (respirable dust and fume, as V2O5)
Quebec:	0.05 mg/m3 TWAEV (fume and respirable dust, as V2O5)
Saskatchewan:	0.05 mg/m3 TWA (respirable size dust and fume, as V2O5)
	0.15 mg/m3 STEL (respirable size dust and fume, as V2O5)

Material Safety Data Sheet



ID: C-405

Material Name: SCR Systems NOx Catalyst

Engineering Controls

If material is ground, cut, or used in any operation which may generate dusts, use appropriate local exhaust ventilation to keep exposures below the recommended exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Wear safety glasses with side shields.

Personal Protective Equipment: Skin

Wear leather or other appropriate work gloves, if necessary for type of operation. The use of coveralls is recommended.

Personal Protective Equipment: Respiratory

If ventilation is not sufficient to effectively prevent buildup of vapor/mist/dust/fume, appropriate NIOSH respirator protection must be provided.

Personal Protective Equipment: General

Use good hygiene practices when handling this material including changing and laundering work clothing after use.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Yellowish green to beige/grey solid	**Odor:**	Odorless
Physical State:	Solid	**pH:**	Not applicable
Vapor Pressure:	Not applicable	**Vapor Density:**	Not applicable
Boiling Point:	Not applicable	**Solubility (H2O):**	Slight
Freezing Point:	Not applicable	**Particle Size:**	Not applicable
Softening Point:	Not applicable	**Evaporation Rate:**	Not applicable
Viscosity:	Not applicable	**Bulk Density:**	Not determined
Percent Volatile:	Not applicable	**Molecular Weight:**	Not applicable
Density:	4 gm/cm3	**Auto Ignition:**	Not applicable
Flash Point:	Not applicable	**Flash Point Method:**	Not applicable
Lower Flammability Limit (LFL):	Not applicable	**Upper Flammability Limit (UFL):**	Not applicable
OSHA Flammability Classification:	Not applicable		

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

Stable

Chemical Stability: Conditions to Avoid

Avoid generation of airborne dusts.

Incompatibility

Avoid contact with oxidizing agents.

Hazardous Decomposition

Metallic oxides.

Possibility of Hazardous Reactions

Will not occur.

* * * Section 11 - Toxicological Information * * *

Acute Dose Effects

A: General Product Information

Overexposure to dusts from this product may cause eye irritation including irritation, redness, scratching of the cornea, and tearing. Mechanical irritation from inhalation of product dust may cause coughing, soreness of throat and nose, and sneezing.

Exposure to vanadium pentoxide for only a few days may cause rhinitis, dryness of the throat, hoarseness, bronchitis with coughing and wheezing, dyspnea, and pneumonitis. Chronic effects include lung damage, damage to the blood forming elements, and central nervous system effects. Vanadium pentoxide dusts may cause a sensation of burning and irritation of eyes and signs of conjuctivitis and may also produce an allergic skin reaction. Acute exposure to vanadium pentoxide may cause a green discoloration of the tongue.

Material Safety Data Sheet

Material Name: SCR Systems NOx Catalyst

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B: Component Analysis - LD50/LC50
Tungsten oxide (1314-35-8)
Oral LD50 Rat: 1059 mg/kg

Vanadium Pentoxide (1314-62-1)
Inhalation LC50 Rat: 2.21 mg/L/4H; Oral LD50 Rat: 10 mg/kg; Dermal LD50 Rat: >2500 mg/kg

Carcinogenicity
A: General Product Information
No information available for product.
B: Component Carcinogenicity
Vanadium Pentoxide (1314-62-1)
ACGIH: A4 - Not Classifiable as a Human Carcinogen (dust and fume)
IARC: Monograph 86, in preparation (Group 2B (Possibly carcinogenic to humans))

Other Toxicological Information
Under normal conditions of use for ceramic products, the likelihood of inhaling or ingesting amounts necessary for these effects to occur is very small.

* * * Section 12 - Ecological Information * * *

Ecotoxicity
A: General Product Information
No data is available.
B: Component Analysis - Ecotoxicity - Aquatic Toxicity
No ecotoxicity data are available for this product's components.
Environmental Fate
No data for this product is available.

* * * Section 13 - Disposal Considerations * * *

US EPA Waste Number & Descriptions
A: General Product Information
You must test your waste using methods described in 40 CFR Part 261 to determine if it meets applicable definitions of hazardous wastes.
B: Component Waste Numbers
No EPA Waste Numbers are applicable for this formulated product.
Disposal Instructions
Waste must be handled in accordance with all federal, state, provincial, and local regulations.
See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

* * * Section 14 - Transportation Information * * *

US DOT Information
Shipping Name: Not regulated as a hazardous material

TDG Information
Shipping Name: Not regulated as a dangerous good.

* * * Section 15 - Regulatory Information * * *

US Federal Regulations
A: General Product Information
All components are on the U.S. EPA TSCA Inventory List.

Material Safety Data Sheet

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Material Name: SCR Systems NOx Catalyst

B: Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Vanadium Pentoxide (1314-62-1)

SARA 302: 100 lb TPQ (lower threshold), 10000 lb TPQ (upper threshold)
CERCLA: 1000 lb final RQ; 454 kg final RQ

State Regulations

A: General Product Information

Other state regulations may apply. Check individual state requirements.

B: Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Ceramic materials and wares, chemicals ('related to Nuisance particulates)	66402-68-4	No	No	No	No	No	Yes'
Vanadium Pentoxide	1314-62-1	Yes	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Canadian WHMIS Information

A: General Product Information

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all information required by CPR.

WHMIS Classification:

D2A - Cancer, Teratogenic effects at >0.1%
D2B- Irritating to eyes and skin. Skin sensitizer.

B: Component Analysis - WHMIS IDL

The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Vanadium Pentoxide	1314-62-1	0.1 %

Additional Regulatory Information

A: General Product Information

No additional information.

B: Component Analysis - Inventory

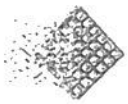
Component	CAS #	TSCA	DSL	EINECS
Ceramic materials and wares, chemicals	66402-68-4	Yes	Yes	Yes
Tungsten oxide	1314-35-8	Yes	Yes	Yes
Vanadium Pentoxide	1314-62-1	Yes	Yes	Yes

* * * Section 16 - Other Information * * *

Other Information

Reasonable care has been taken in the preparation of this information, but Cormetech makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. Cormetech makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use.

Material Safety Data Sheet



ID: C-405

Material Name: SCR Systems NOx Catalyst

Revision Information:
Revision 1.0000, 02-MAY-2006: New MSDS.

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists. CERCLA = Comprehensive Environmental Response, Compensation and Liability Act. CFR = Code of Federal Regulations. DSL = Canadian Domestic Substance List. EINECS = European Inventory of New and Existing Chemical Substances. EPA = Environmental Protection Agency. HEPA = High Efficiency Particulate Air. HMIS = Hazardous Material Identification System. IARC = International Agency for Research on Cancer. NFPA = National Fire Protection Association. NIOSH = National Institute of Occupational Safety and Health. NJTSR = New Jersey Trade Secret Registry. NTP = National Toxicology Program. OSHA = Occupational Safety and Health Administration. NA = Not available or Not Applicable. SARA = Superfund Amendments and Reauthorization Act. TLV = Threshold Limit Value. TSCA = Toxic Substance Control Act. WHMIS = Workplace Hazardous Materials Information System.

End of Sheet C-405